



Overview

Longitudinal Health Surveillance (LHS)

Executive Summary

Longitudinal Health Surveillance (LHS), known at NASA as Occupational Surveillance, includes the medical procedures and actions taken to ensure the in-mission and long-term health of the astronaut. It also provides a mechanism to document any observed spaceflight-associated changes. LHS includes a wide variety of health-related topics that are performed pre-, in-, and post-mission. Training, countermeasures, and post-mission reconditioning should all be employed to help the crewmember achieve, maintain, and recoup their maximal health status. In addition, pre-mission measures help to reduce the need for more extensive in-mission medical care, as well as mitigate the risks of spaceflight. By taking a prevention approach rather than a reactionary approach, the impact to the crewmember’s health will be ameliorated.

Consideration of the impact of the exposure on individuals health should be assessed and monitored accordingly with a surveillance approach.

Pre-mission		In-mission		Post-mission	
Selection Standards					
	Health Stabilization Program				
		In-mission Medical Treatment & Capabilities	Immediate Post-landing Care		
Longitudinal Health Surveillance					

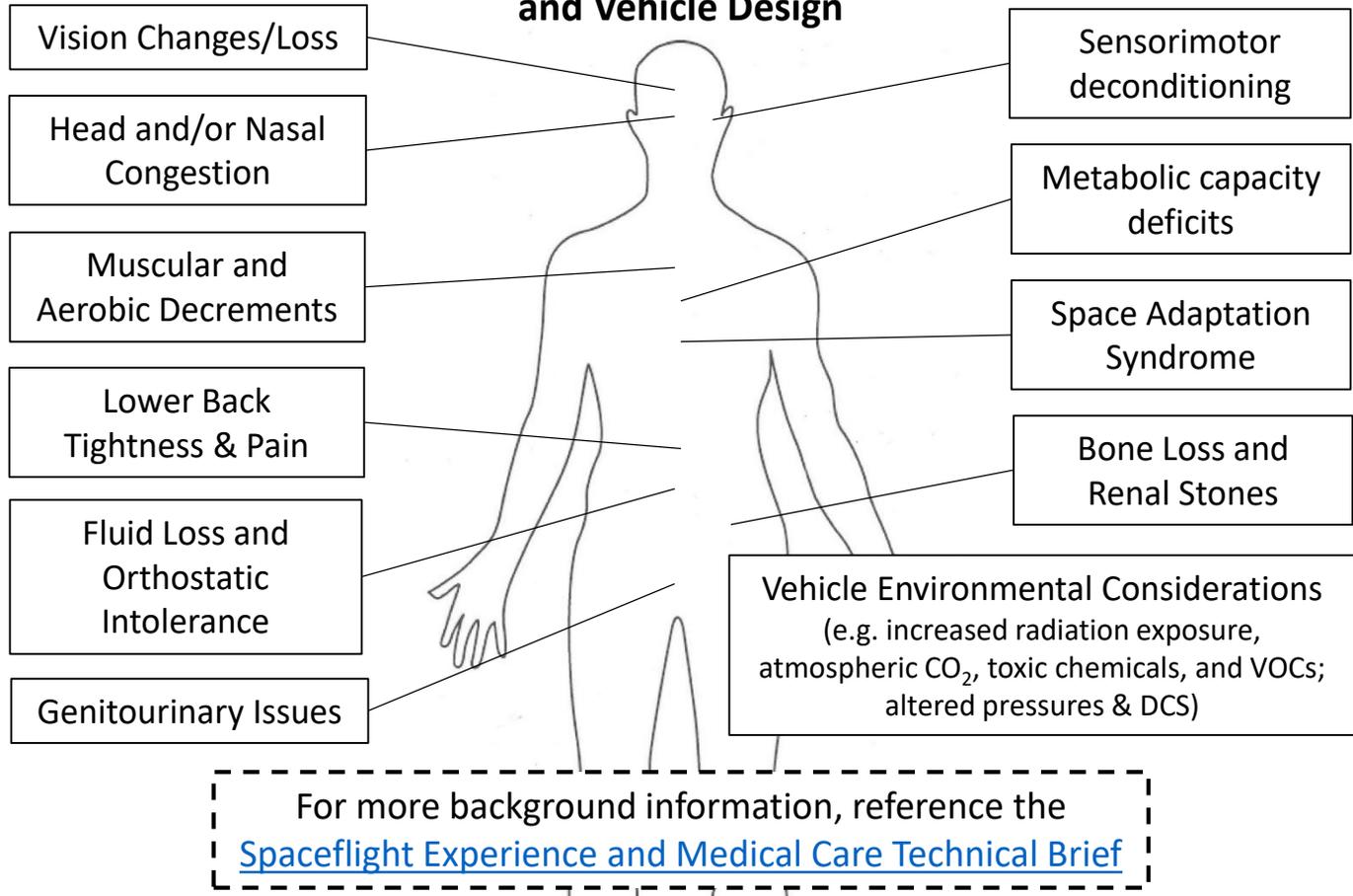
The above table displays the interaction between five key elements that are necessary to promote crew health and performance:

1. Crew Selection Standards
2. Health Stabilization Program (HSP) – [Health Stabilization Program Technical Brief](#)
3. In-mission Medical Treatment & Capabilities – [Spaceflight Experience and Medical Care Technical Brief](#)
4. Immediate Post-landing Medical Care – i.e. medical care post-flight/post-mission
5. Longitudinal Health Surveillance – covered in this technical brief



Background

Prevalent Physiologic Changes Experienced due to Microgravity and Vehicle Design



TREAT Astronauts Act

- The NASA “To Research, Evaluate, Assess, and Treat Astronauts” (TREAT) ACT is the authorization to enable NASA to provide care for “occupationally related medical monitoring, diagnosis, and treatment for our former astronauts who have completed at least one spaceflight mission.”
- Covers all conditions that NASA considers “potentially associated” with spaceflight
- Enhanced the Lifetime Surveillance of Astronaut Health, an established NASA effort



Reference Data

NASA's Procedures for Longitudinal Health Surveillance

NASA employs pre-, in-, and/or post-mission procedures for the following topics depending on mission duration and architecture. Each topic, if implemented, differs in the phase of the mission they are used, measurement parameters (e.g. vitals, lab tests, etc.), and deliverables (e.g. reports, Electrical Medical Record submissions, downlinks, etc.).

Physical exam (pre-, in-, & post-)	ECG (pre- & post-)	Neurological assessment (pre-, in-, and post-)*
Neurovestibular Platform Test (pre- & post-)*	Hearing assessment (pre-, in-, & post-)	Body mass measurement (in-)
Nutritional assessment (pre-, in-, & post-)	Dental exam, with orthopantomogram (pre-)	Eye examination (pre-, in-, & post-)*
Ultrasound imaging (pre-)*	Photodocumentation of the skin (as required; in-, post-)	Laboratory testing (pre-, in-, post-)*
<i>H. pylori</i> and Tuberculosis testing (pre-)	MRSA nasal screen and suppression (pre- & post-)	Radiation monitoring /Personal Dosimetry (in- & post-)
Toxicological assessment, with air & water quality monitoring (in-)	Microbial analysis (in-)	EVA medical monitoring and prebreathe protocols (pre- & in-)
Psychiatric/Psychological status check (pre-, in-, & post-)	Cognitive assessment (pre- & post-)	Observation of training by behavioral health & performance team (pre-)
Bone densitometry (pre- & post-)	Functional fitness assessment (pre- & post-)*	Exercise (aerobic & resistive; in-)
Isokinetic testing, or equivalent (pre- & post-)*	Aerobic functional capacity testing (pre-, in-, & post-)	

**Denotes topics that have additional information listed on the following slide*

Reference Documents

- NASA Johnson Space Center Space Medicine Operations – Medical Requirements - MedBs and MRIDs Summary of H.R.6076, 114th Congress – <https://www.congress.gov/bill/114th-congress/house-bill/6076>
- NASA's "TREAT Astronauts Act FAQs" – <https://www.nasa.gov/hhp/treat-act>

NASA Office of the Chief Health & Medical Officer (OCHMO)

This Technical Brief is derived from NASA-STD-3001 and is for reference only. It does not supersede or waive existing Agency, Program, or Contract requirements.



Reference Data

NASA's Procedures for Longitudinal Health Surveillance

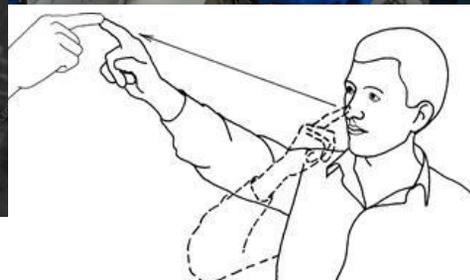
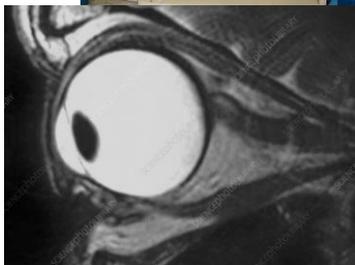
Additional information on select LHS topics

- Neurological & neurovestibular assessments
 - Dynamic Posturography – pre- and post-mission (L-90/30 and R+8 days, resp.)
 - Pre- & post-mission neurological assessment (performed in conjunction with physical exams) – neurological signs & symptoms (e.g. headache, vertigo), motor performance (gaze/ocular movements, finger-to-nose test, drift), and gait & station (rising from chair, standing/ Romberg, leg lift – hop, tandem/heel-to-nose walk, and dynamic equilibrium)



Eye examinations

- Pre-mission – L-21/18 m and/or L-9/6 m
 - MRI; eye exams (incl. visual acuity – distance & near; refraction – manifest & cycloplegic; threshold visual fields; Amsler grid; contrast sensitivity; pupil reflexes; extraocular muscle balance; biomicroscopy; dilated fundoscopic examination; retinal photography; tonometry; optical coherence tomography (high res), including SVP videography; optical biometry); contact lens / spectacle fitting; 2-D imaging ultrasound
 - Less comprehensive eye exam on L-90/30 days
- In-mission – L+30 d, L+90 d, L+180 d, L+270 d, and/or R-30 d; or, as clinically indicated
 - Visual testing with and without contrast sensitivity (incl. acuity – near and far; and Amsler Grid); fundoscopy; 2-D imaging ultrasound; OCT; tonometry
- Post-mission – 1-3 days post-landing, unless otherwise noted
 - Eye exam immediately post-landing
 - Comprehensive eye exam (details listed above); MRI; 2-D imaging ultrasound





Reference Data

NASA's Procedures for Longitudinal Health Surveillance

Additional information on select LHS topics

- Ultrasound imaging
 - Pre-mission – <L-365 d, or as clinically indicated
 - Abdominal and retroperitoneal ultrasound (males and females); pelvic ultrasound (females)
- Laboratory testing
 - Pre-mission – L-90/30 d
 - Blood collection – hematology, chemistry profile, ionized calcium, thyroid function, iron profile, and any special chemistries (e.g. C-reactive protein, serum lipids, mouse IgE allergen panel, etc.)
 - Variable urine collection – urinalysis and pregnancy test
 - Post-mission – R+0/1 d, R+3/7 d (as clinically indicated), and R+14/30 d
 - R+0/1 days: blood collection (hematology, i-Stat parameters); urinalysis
 - R+3/7: blood collection, as in pre-mission
 - R+14/30: blood collection (as in pre-mission) and urinalysis
- Functional fitness assessment – L-6/9 m, L-90/30 d, R+5/7, and R+30
 - Pre- & post-mission – sit and reach, bench press, push-ups, sit-ups, pull-ups, leg press, cone agility test, stand test, and hand grip
- Isokinetic testing – L-9/6 m, L-90/30 d, R+5 d, R+14 d, and R+30 d
 - Pre-mission – concentric knee extension & flexion, concentric ankle plantarflexion & dorsiflexion, eccentric ankle plantarflexion & dorsiflexion, and concentric trunk extension & flexion

